

digital energy journal

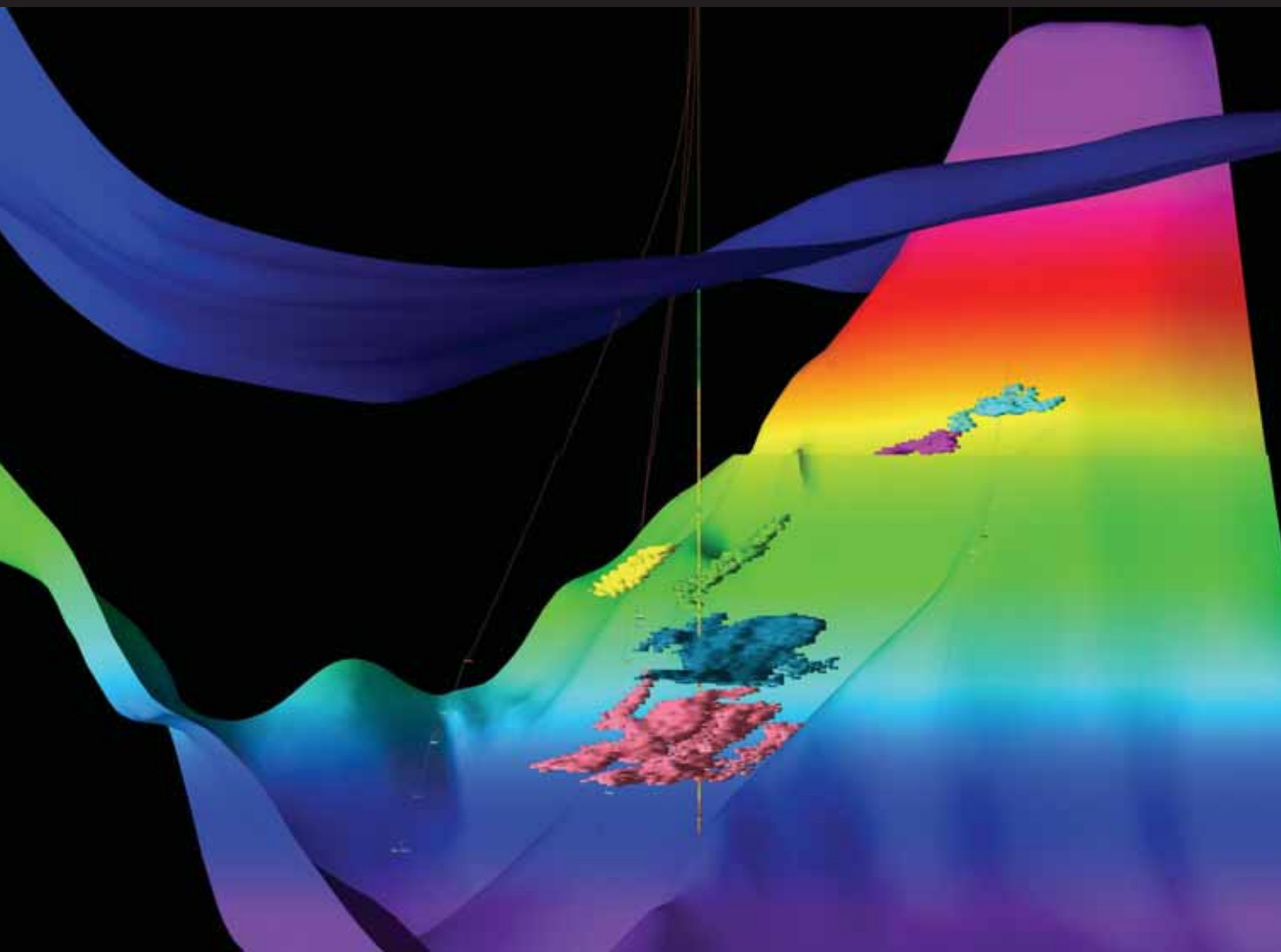
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Issue 16

Exploration: Wireless seismic surveys - faster and with less environmental impact

Drilling: Save \$13m per year per rig using wired drill pipe instead of mud pulse

Procurement: How much do you really know about your spending?



Integrated operations:
Is it about computers or people?



Doing pore pressure predictions

Before drilling, it is helpful to know about pore pressure – not only in your expected reservoirs, but in the rock above and below them – so you can prevent kicks, design the proper casing plan, get the right mud weight and avoid drilling hazards. We spoke to Gary Yu, chief geophysicist with Geotrace (previously manager of Worldwide Geophysical Benchmark at TOTAL, France), about how this is done.

When drilling, it is very helpful to know in advance what kind of pressures you might be drilling through.

That way, you can avoid “kicks” (a sudden flow of oil or gas into the wellbore and rushing to the surface, potentially causing a big accident) and “tool sticking” (when the drill string cannot move) due to pressure difference between wellbore and formation.

You can also make sure you choose the right casing setting depths and purchase the appropriate casing strings. You can get the mud weight right – if the mud pressure is higher than the reservoir pressure you can lose mud flow through the wellbore and if it is too low you can lose the circulation and get your tool stuck. Both cases are the main reasons for the loss time and money in drilling.

You can also get an understanding of the pressures in the rock above and below the reservoir, which might be needed to push oil and gas into your well.

“Every year, we have these pore pressure problems, causing tens of billions of dollars,” says Mr Yu. “You should try to predict pore pressure as much as you can.”

With a good pore pressure prediction, “drillers can make the plan before they start drilling,” he said.

“We can give them the pressure profile along their entire drilling path – and we can tell their uncertainty,” he says. “The driller can plan their drilling program around it.”

“I really encourage our clients to do it as much as possible,” he says. “Its costs are a very small fraction of the overall drilling cost.”

“It’s more and more common to put together models of the pore pressure,” he says. “Today – most of the large oil companies will do a pore pressure prediction for nearly every well.”

Pore pressure analysis has always been included as part of geophysical analysis (to help work out where the oil is), but Geotrace is suggesting using it to help with engineering.

Geologists will always make lots of pressure calculations about the reservoir – their primary focus of attention – but engineers will benefit from pore pressure studies of the rock above and below the reservoir (the overburden and underburden).

For example, if the overburden is shale, as it is in much of the Gulf of Mexico, it can have water stuck in the pores, which creates

pressure due to undercompaction. We also take secondary factors such as fluid expulsion, shale diagenesis, lateral transfer, and tectonic loading into consideration when it is feasible.

Calculating pore pressure

Pore pressure is estimated using a combination of seismic data and well logs of existing wells.

Sonic logs can help provide information about pressure in wells that have already been drilled, he says.

“To put together a pore pressure study for a typical offshore project, say 100 – 200 square miles, would take one or two months,” he says. “We can make it faster if the client needs it.”

Geotrace puts together a high-resolution, 3D model of pore pressures, made up of a number of tiny 3D cells.

The system needs to be corrected for anisotropy (when pressure is different in different directions).

Geotrace aims to work with as high resolution data as possible through the drilling process.

“One of our goals we try to reach, from physics to geology to reservoir to engineering, is to try to do everything in high resolution,” he says. “We can extract the high resolution information out of seismic – much better than many other companies. Geotrace has a lot of experience in different areas.”

“There’s a lot of technology involved, developed over five to 10 years, to transform high-resolution velocity into high-resolution pressure,” he says.

“We do it with higher resolution and with uncertainty – we can plan much better,” he says.

A pore pressure model can be imported into reservoir modelling software such as Petrel, or be used by itself when planning the drilling.

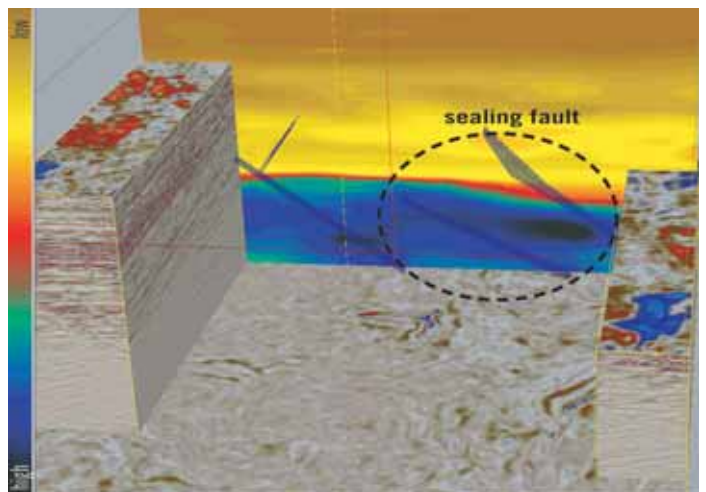


“You should try to predict pore pressure as much as you can.” - Gary Yu, chief geologist with Geotrace

If companies are not used to working with pore pressure, Geotrace can help, Mr Yu says.

“We can but may not deliver the client all of the information if they so desire because – we say – if we deliver you a set of seismic derived attributes – we’ll tell you what are the most significant to save client’s time on business decision.”

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A 3D colour coded image of pore pressure in the subsurface (yellow = low pressure, red = medium, blue = high pressure) - you can check seal integrity, and look for drilling hazards, before starting to drill